Package ‘fcoxFr’

December 13, 2024

Type Package

Title Functional principal component Cox regression with frailty

Version 1.0

Depends R (>= 3.5.0), fda, MASS, survival, coxme

Imports expm, fda.usc

LazyLoad yes

ByteCompile TRUE

Encoding UTF-8

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Description Functions for implementing estimation methods for functional principal component Cox regression with frailty.

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Contents

`data_generation` *Generate data for functional cox regression model with frailty*

Description

This function is used to simulate data for the functional cox regression model with frailty

$$h_i(t|\boldsymbol{Z}_i, X_i, \boldsymbol{w}) = h_0(t)\exp\left(\boldsymbol{Z}_i^\top\boldsymbol{\gamma} + \int_{\mathcal{I}} X_i(s)\beta(s)ds + \boldsymbol{U}_i^\top\boldsymbol{w}\right),$$

where $h_0(t)$ is the baseline hazard function, $h_i(t|\boldsymbol{Z}_i, X_i, \boldsymbol{w})$ is the hazard function incorporating frailty for subject i, $\boldsymbol{\gamma} = (\gamma_1, \ldots, \gamma_p)^\top$ is the vector of regression coefficients, $\beta(s)$ is the functional regression coefficient, and the frailty for subject i, $\boldsymbol{w}_i$, captures the effect of unobserved factors influencing the risk of the event for subject i. Here, $\boldsymbol{U}_i = (U_{1i}, \ldots, U_{ki})^\top$ is a k-dimensional indicator vector that indicates the family of i-th individual.

Usage

```
data_generation(n, j, p, gamma0, tau, mev, theta)
```

Arguments

n	An integer, specifying the number of observations to be generated.
j	An integer, denoting the number of grid points, i.e., a fine grid on the interval [0, 1].
p	An integer, denoting the number of scalar predictors to be generated.
gamma0	A vector, containing the parameters for the scalar predictors.
tau	A numeric value, denoting the rate parameter of exponential censoring distribution.
mev	A numeric value, denoting the measurement error variance.
theta	A numeric value, denoting the scale parameter of the gamma distribution.

Value

time	A numeric vector of length n representing the observed time-to-event or censoring times for each individual. This is the minimum of the failure time and the censoring time.
event	A binary numeric vector of length nn indicating whether an event occurred (11) or if the observation was censored (00).
Xt	A matrix representing the functional predictor observations for each individual, including measurement error. Each row corresponds to the observed functional predictor values at j grid points.
Xt_true	A matrix representing the true (unobserved) functional predictor values for each individual, without measurement error.
Z	A matrix representing the scalar predictor values for each individual.
beta	A numeric vector of length j representing the true functional coefficient values $\beta(s)$ evaluated at the j grid points.
gamma	A numeric vector containing the regression coefficients for the scalar predictors.
gp	A numeric vector of length j containing the grid points where the functional predictor and functional coefficient are evaluated. These values range from 0 to 1, equally spaced.

Author(s)

Deniz Inan, Ufuk Beyaztas, Carmen D. Tekwe, Xiwei Chen, and Roger S. Zoh

References

Kong, D., Ibrahim, J. G., Lee, E. and Zhu, H. (2018), ‘FLCRM: Functional linear Cox regression model’, Biometrics 74(1), 109–117.

`fpcr` *Functional principal component Cox regression with frailty*

Description

Estimates the coefficients for a functional Cox regression model with optional frailty, incorporating scalar covariates and functional principal components for the functional predictor.

Usage

```
fpcr(time, event, group = NULL, X, Z, weights = NULL, nb, gp)
```

Arguments

- `time` A numeric vector representing the time-to-event or censoring time for each observation.
- `event` A binary numeric vector indicating whether the event occurred (`1`) or was censored (`0`).
- `group` (Optional) A grouping variable for frailty effects, such as cluster IDs. If `NULL`, no frailty term is included.
- `X` A matrix of dimensions \(n \times j \), where \(n \) is the number of observations, and \(j \) is the number of grid points for the functional predictor.
- `Z` A matrix of dimensions \(n \times p \), where \(p \) is the number of scalar predictors.
- `weights` (Optional) A vector of weights for each observation. If `NULL`, equal weights are used.
- `nb` An integer specifying the number of B-spline basis expansion functions used to approximate the functional principal components.
- `gp` A numeric vector representing the grid points corresponding to the functional predictor.

Value

A list with the following components:

- `bhat` A numeric vector representing the estimated functional coefficient \(\hat\beta(s)\) evaluated at the grid points `gp`.
- `gammahat` A numeric vector of estimated scalar regression coefficients for the covariates `Z`.
- `concordance` The concordance index for the fitted Cox model, measuring the model's predictive accuracy.
- `model` The fitted `coxme` model object.
- `fpca` The result of the FPCA performed on the functional predictor, including principal component scores, eigenvalues, and eigenfunctions.

Author(s)

Deniz Inan, Ufuk Beyaztas, Carmen D. Tekwe, Xiwei Chen, and Roger S. Zoh

Examples

```
## Example Usage
set.seed(123)
# Simulate data
sim_data <- data_generation(n = 100, j = 101, p = 6, gamma0 = rep(0.5, 6),
                            tau = 0.2, mev = 0.5, theta = 2)
# Apply fpcr
fit <- fpcr(time = sim_data$time, event = sim_data$event, X = sim_data$Xt,
            Z = sim_data$Z, nb = 10, gp = sim_data$gp)
```

`fpcr_predict` *Prediction for functional Cox regression models with frailty*

Description

Generates predictions for a functional Cox regression model with frailty, using new functional and scalar predictors, and calculates the concordance index.

Usage

```
fpcr_predict(object, time, event, group = NULL, X, Z, nb, gp)
```

Arguments

`object`	An `fpcr` object, representing a fitted functional Cox regression model.
`time`	A numeric vector representing the time-to-event or censoring time for new observations.
`event`	A binary numeric vector indicating whether the event occurred (1) or was censored (0) for new observations.
`group`	(Optional) A grouping variable for frailty effects, such as cluster IDs for new data. If `NULL`, no frailty term is included.
`X`	A matrix of dimensions \(n \times j \), where \(n \) is the number of new observations and \(j \) is the number of grid points for the functional predictor.
`Z`	A matrix of dimensions \(n \times p \), where \(p \) is the number of scalar predictors for the new observations.
`nb`	An integer specifying the number of B-spline basis expansion functions used to approximate the functional principal components.
`gp`	A numeric vector representing the grid points corresponding to the functional predictor.

Value

A list with the following components:

`predictions`	A numeric vector of predicted values (linear predictors) for the new observations.
`concordance`	The concordance index for the predictions, measuring the model's predictive accuracy.

Author(s)

Deniz Inan, Ufuk Beyaztas, Carmen D. Tekwe, Xiwei Chen, and Roger S. Zoh

Examples

```
## Example Usage
set.seed(123)
# Simulate training data
train_data <- data_generation(n = 100, j = 101, p = 6, gamma0 = rep(0.5, 6),
                             tau = 0.2, mev = 0.5, theta = 2)
# Fit fpcr model
fit <- fpcr(time = train_data$time, event = train_data$event, X = train_data$Xt,
            Z = train_data$Z, nb = 5, gp = train_data$gp)

# Simulate new data for prediction
test_data <- data_generation(n = 100, j = 101, p = 6, gamma0 = rep(0.5, 6),
                             tau = 0.2, mev = 0.5, theta = 2)

# Apply fpcr_predict
predictions <- fpcr_predict(object = fit, time = test_data$time, event = test_data$event,
                             X = test_data$Xt, Z = test_data$Z, nb = 5, gp = test_data$gp)
```

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